MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

EEE 7296 – ENERGY AUDITING AND MONITORING

14 OCTOBER 2016
09am-12pm
(3 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages including cover page with 4 Questions only.

2. Answer ALL questions. All questions carry equal marks and the distributions of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

a) Define the term 'Building Efficiency Index (BEI)'.

[4 marks]

b) Highlight the superiority of representing BEI in kWhr/m^2/year and kWhr/m^2/year/person.

[4 marks]

c) Calculate BEI (kWhr/m^2/year) for a company office building. The building and energy data are given in appendix A. Assume 80% of floor area occupied and the operating time is 9 hours daily. The office remains open for 5 days in a week. [17 marks]

Question 2

a) The half hourly energy data of a transformer manufacturing company is depicted in Table Q2 (a). The data is collected for two days, Monday and Tuesday. The production rate for both the days is the same.

(i) Plot the energy value in kWhr versus time in a graph sheet. Compute losses (if any) during the operation.

[11 marks]

(ii) Analyze the data and point out if the company's production line is running efficiently.

[4 marks]

Table Q2 (a)

Time	800	830	900	930	1000	1030	1100	1130	1200	1230	1300	1330	1400	1430	1500	1530	1600	1630	1700	1730
Monday (kWhr)	2300	2500	2600	2700	3400	5300	6740	6300	7800	6720	6930	6320	5800	5900	5530	4820	4790	3490	3390	2900
Tuesday (kWhr)	2300	2700	2540	2630	2900	4890	5760	5780	5600	5400	5900	5870	5490	5600	5270	5400	4600	3120	2950	2650

b) Table Q2 (b1) and Q2 (b2) present the energy data for two years of a building. Analyze the energy data and explain if the building operates efficiently. Given below are the company details.

It is an administration block for a University, operating from 8.00 AM to 5.30 PM (Monday to Friday only). Usually guest and students visit this place daily.

[10 marks]

Continued...

Table Q2 (b1): Administrative block Electrical consumption (Thousand Kwh)

	2014	2015
Jan	23	26
Feb	24	24
March	26	20
April	25	35
May	27	25
June	25	26
July	24	24
Aug	25	25
Sept	25	22
Oct	26	30
Nov	34	24
Dec	25	25

Table Q2 (b2): Number of Visitors

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Number of Visitors, 2014	1800	2050	2100	2200	2070	2150	2060	2100	2030	2120	2800	2150
Number of Visitors, 2015	2000	2100	1100	2300	2050	2100	1980	2010	1870	2050	2010	1980

Question 3

a) From the point of view of energy auditing of a small company, explain the following:

(i) ECM interactions

[5 marks]

(ii) Procedure for establishment of HVAC loads profile.

[3 marks]

(iii) Changes of load following air and water flows vs. constant flow

[3 marks]

b) In energy conservation measures, list five low cost opportunities for cost savings.

[5 marks]

c) In an unbalanced 3-phase distribution system the load draws 150 A, 180 A and 120 A in the three phases. Compute the extra power loss due to unbalancing. Assume the neutral wire has half the cross section of the phase wire and same power factor for each load.

[4 marks]

Continued…

d) A small indoor stadium is to be illuminated with 10 HPMV lamps having each of 80 W rating. The other alternative is to replace the HPMV lamps with 10 groups of LED lamps having 30 W rating for each group. Both the system produces same illumination. If the cost of the LED lamp is 2.5 times the HPMV lamp, compute the number of months after which excess cost of LED lamps will be compensated by the savings in the energy cost. Given energy cost of RM 0.2/kWh, number of working hours per day is 6.
[2 marks]

e) A motor in an air-conditioner works on ON/OFF mode with 12 mins ON and 8 mins OFF period in each cycle. It draws full load current at 0.9pf during the ON period. To maintain the same temperature, the motor may also run continuously at a lower speed drawing 80% of the full load current at 0.8pf. Compute the energy saving per day.
[3 marks]

Question 4

a) Briefly explain the working of the following Energy Audit instruments.

(i) Flue Gas analyzer
[6 marks]

(ii) Leak testing and detection
[5 marks]

(iii) Remote sensing thermometer or Pyrometer
[5 marks]

(iv) Ultra-sonic flow meter for measuring fluid velocity
[5 marks]

b) One 100 Watt bulb is having length 40 cm, radius 0.05 m. if emissivity is 0.85, calculate the temperature.
[4 marks]

Continued…

Appendix A

$$BEI = \frac{(TBEC - CPEC - DCEC)}{(GFA - DCA - (GLA \times FVR))} \times \frac{52}{WOH}$$

TBEC – Total Building Energy Consumption (kWh/year)
CPEC – Carpark Energy Consumption (kWh/year)
DCEC – Data Centre Energy Consumption (kWh/year)
GFA – Gross Floor Area exclusive of car park (m2)
DCA – Data Centre Area (m2)
GLA – Gross Lettable Area (m2)
FVR – Weighted floor vacancy rate of GLA (%)
52 – Typical weekly hours of office buildings in KL/Malaysia (hrs/week)
W O H – Weighted weekly operating hours of GLA exclusive of DCA (hrs/week)

Building data:

GFA = 48000 mm x 32000 mm = 1536 m^2

Common and Service Areas

1. Réception Lobby (8 x 11 = 88 m^2)
2. Lift Lobby (8 x 10 = 80 m^2)
3. Waiting Areas (8 x 8 = 64 m^2)
4. Registration (5.975 x 10.575 = 63.185 m^2)

Energy Data

I. Air conditioning KWH
   - Jan – March - 32900
   - April – June - 44400
   - July – Sept - 41000
   - Oct – Dec - 38100

II. Light
   - Jan – March - 17600
   - April – June - 20600
   - July – Sept - 22400
   - Oct – Dec - 25200

End of Paper